Towards a Classification and Lifecycle of Business Process Change

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Abstract. Business processes in dynamic environments are often subject to disruptions, forcing organizations to change their processes. This gives rise to the question how and when such process change should be considered during the process lifecycle and how it could be anticipated in order to decrease response time. In line with recent proposals to study the extrinsic drivers of process change, we seek the reasons for modifications outside the typical process environment and derive several process change strategies. Future work will describe the relation between external events and these strategies to yield ameliorated and truly flexible process designs.

Keywords: Process lifecycle, process change, process flexibility

Introduction

It is a common phenomenon that companies face disturbances in their daily operations. A multitude of external events can spark these disruptions, leading to different degrees of impact from minor discontinuities to situations that threaten the organisation's ability to remain in business. It is therefore vital for organisations to understand environmental factors that drive change and assess their impact on business processes. This raises the question how and when organisations may detect and act upon disturbances throughout the business process lifecycle. Business Process Management (BPM) is "a systematic, structured approach to analyse, improve, control, and manage processes with the aim of improving the quality of products and services" [1]. In this context, business process flexibility is the capacity of the organisation to respond to change by modifying only those parts of a process that require adaptation while keeping other parts stable [2].

Rosemann et al. [3, 4] observe that process flexibility consists of two parts: an extrinsic driver of change and an intrinsic measure of process adaptation. However, the relation between extrinsic drivers and business process change remains largely undiscussed. Hence, the authors propose to investigate the impact of contextual variables

on business processes and how different values for these variables necessitate different responses. Yet, an overarching framework that guides organizations in the application of this approach is currently missing. In particular, it is still unclear what options organizations face in light of an identified need for change, how different process change strategies can be characterized and in which situations they are applicable.

Accordingly, in this paper we continue along this line and work and extend our previous research questions [3] as follows:

1. What are recurring process change strategies?
2. What are indicators for the applicability of such strategies?
3. How can process change be incorporated into the business process lifecycle?

As a first step towards support for contextualized process design, we have conducted a review of case studies in the literature to better understand the specific requirements of business process change. Our findings suggest that there are certain recurring scenarios with respect to the strategies organizations apply when responding to extrinsic change. This paper discusses the general properties of these scenarios and seeks to derive a classification of process change strategies. Future work will investigate the characteristics of change drivers and their relation to response strategies to arrive at a more general understanding of the problem. Ultimately, our research aims at providing insights into how contextual design can be applied in the business process lifecycle to arrive at ameliorated process designs.

The remainder of this paper is structured as follows. Section 2 introduces a set of high-level, generic process change strategies. The classification will then be assessed in more detail in section 3. We briefly discuss the state of the art of change support in process–aware information systems (PAIS) in section 4. Finally, section 5 concludes our findings and provides an outlook to future research.

A Classification and Lifecycle of Process Change Strategies

An initial review of case studies extracted from the literature [5, 6] or through empiric research conducted by us [4, 7], suggests the recurrence of several scenarios. We found that albeit the scales of events that trigger a scenario differ to some extent across the considered cases, each scenario demonstrates the ability of organizations (or lack thereof) to flexibly react to change occurring in its immediate environment. The list of scenarios we have analysed is non-exhaustive as the subject of consideration is in constant evolution and future extensions may thus be required. We nonetheless believe that other attributes of research are satisfied, such as comprehensive representation of each scenario and the abstraction into distinct classes.

In one instance, a multi-national manufacturer of automobiles has to respond to a major Atlantic hurricane threatening to destroy assembly plants in the immediate proximity of projected landfall points [5]. This event poses a major threat to its entire supply chain and supporting processes. Due to careful emergency planning, the manufacturer is able to airfreight its inventory out of the affected area, track sole source suppliers to gauge the impact on its supply chain and evacuate its staff well in advance. Albeit the hurricane is recorded as one of the costliest and deadliest hurricanes

in the history of the United States, the company is able to report no loss of production and live.

In another instance, a pharmaceutical producer of flu vaccine faces a significant disruption of its manufacturing process [6, 8]. This event is instigated by the discovery of quality control irregularities in its plant in Liverpool, United Kingdom. The isolation of bacteria in five lots of vaccine lead British regulators to the suspension the producer's licence to manufacture flu vaccine and the forced shut down of operations in the plant. Thus, half of the projected supplies required to cover the demand in the North America market during the annual flu season evaporate overnight.

In a third example, we consider the teleclaims process of a large Australian insurance company, which deals with the handling of inbound phone calls, whereby different types of insurance claims (household, car etc.) are lodged over the phone [4, 7]. While this process runs smoothly in a regular business context, the organization faces an increasing number of incoming phone calls during the Australian storm season (October-March). This change puts significant burden on the succeeding back-office processes related to evaluating and managing claims. In order to cope with increased call traffic, the insurance company operates an 'event-based response system' that differentiates a number of categories of situations based on how severe the storms are.

Our analysis of the temporal and structural attributes of process change in these scenarios has led us to the identification of three types of response strategies or *process change strategies*. The respective strategies differ with respect to the perpetuity of the effected change and the extensiveness of structural modification. While we analyse the requirements of each class in the following, we do not intend to mandate specific patterns of structural modifications on a business processes (for a discussion of structural modification patterns see [9]). Instead, we propose a generic classification, which aims to provide guidance on the applicability of concrete change or adaptation strategies.

Strategy 1 – Substitution

Description: The temporary replacement of a business process by another, structurally different business process, typically in response to an extreme event such as an emergency situation.

Examples: Emergency response planning, contingency planning, business continuity

Strategy 2 – Adaptation

Description: The temporary adaptation of the structure of a business process in response to an anticipated and temporary event without erasing the structural identity of the process. Such changes are occurring on a case basis in contrast to evolutionary changes occurring on a type basis.

Examples: Logistics or manufacturing processes as well as supporting processes that are subject to temporary disruptions

Strategy 3 – Evolution

Synonyms: Continuous improvement

Description: The continuous evolution from the current state of a business process to a future state of a business process instigated by a permanent (and sometimes unanticipated) change in the process environment. Changes effected to the business process are permanent, viz. they considerably change the structural composition of the process or process type.

Examples: Continuous improvement can often be observed in manufacturing environments or shopfloor processes. Evolution is a characteristic of supporting process with a high dependency on disruptive regulatory changes such as payroll or human resources.

Our review further suggests that these strategy types do not occur exclusively or in isolation. In fact, different business processes typically run concurrently and with some extent of interdependency. Accordingly, organizations may be required to maintain, and select, several of these strategies to achieve process flexibility in accordance to the requirements of a given situation. We build on, and extend, the contributions of Regev and Wegmann [2] to the research stream of business process flexibility to support this proposition. Regev and Wegmann [2] build on Weick's organizational theory [10] to explain and define process flexibility. Weick distinguishes three main classes of processes in an organization: *enactment*, *selection*, and *retention*.

Following [10], an organization chooses a response strategy from selections it has retained over the course of its operations. With respect to process flexibility, we call this action the *anticipation* of change. The organization anticipates change and reduces the range of all possible events to those that are likely to occur. At the same time, it *selects* the set of response strategies to be applied in such an event. This stage also comprises supporting processes required to detect change and to rehearse and test response strategies (such as the planning of fire drills). The occurrence of an event instigates *enactment* or *acting upon the environment*. During this phase, the organization will be required to enforce the strategies it has defined for this event to achieve an optimal response. After the effects of the event lessen, the organization may enter a *resumption* phase, in which it retains certain transitory actions but overall resumes its normal operations. During this phase, it may preserve selections that have proven to be efficient as well as reject selections that have not yielded satisfactory results.

Fig. 1 depicts how these phases and the respective response strategies can be aligned in an overarching process change lifecycle. Starting from the left, the diagram shows two standard processes P1 and P2 in phase *anticipation*. A supporting substitute process for P1' is in place, but not active. Yet, certain preparatory activities may be performed, indicated by the arrow towards the standard process P1. Upon occurrence of the anticipated extrinsic event, several response strategies are triggered. Control shifts from P1 to its substitute P1' and P2 is adapted according to the prescribed rules. As time progresses and the organization transitions to the *resumption* phase, control is handed back from P1' to P1 and P2 assumes its normal form. As these events unfold, a third process P3 constantly evolves from an initial to its future state, thus implementing the strategy of evolution.

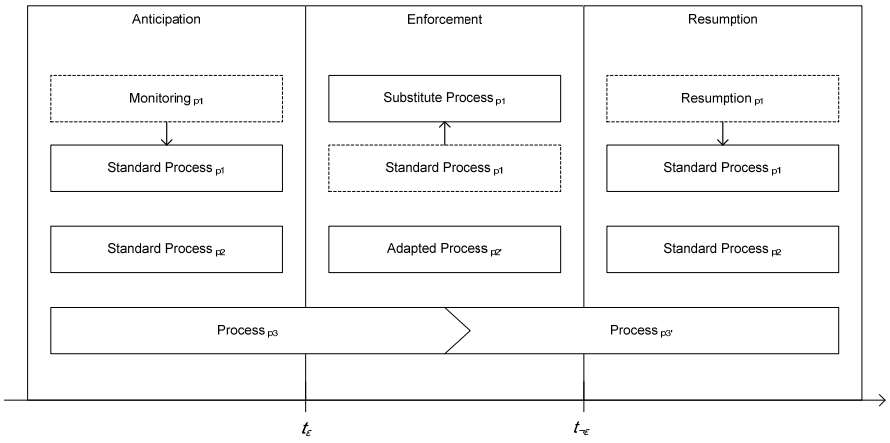

Fig. 1 Process Change Lifecycle in relation to the process classes in [10]

Evaluating the Classification

We will now analyse the attributes of the change strategies introduced above and compare our findings against an existing taxonomy. As outlined before, the list of classes is non-exhaustive and may be extended in the future. The classes we have considered differ along several dimensions. The type and impact of an event largely determine the applicability of a response strategy. By way of example, a major disruption cannot be countered by an evolutionary strategy. Consider the case of 9/11 where due to the threat of future terror attacks airlines and airports radically changed their security processes by substituting current operations with new ones. Clearly, an evolutionary, continuous change strategy was not applicable due to the required change response time (in other words, ASAP).

Predictability (or level of anticipation) is another key distinguishing factor. Some changes (such as season-based changes to a coffee production process) can be anticipated while others (such as a terror attack) are typically unpredictable. Finally, the type and extent of structural changes instigated by the event (e.g., changes to policies or data as opposed to process flow changes) as well as the temporal dimension of the change (e.g., short term versus long term changes) are of importance.

For the validation of our process change strategies, we turn to the taxonomy of business process flexibility proposed by Regev et al. [11], which provides a means for classifying flexibility with respect to the types of changes it enables. The taxonomy distinguishes the *abstraction level* of change, the *subject* of change, and certain *properties* of change. Table 1 summarizes how we applied the taxonomy to the process change strategies introduced above.[1] *Substitution* overrides the 'regular' process with

[1] The notion of subject of change as introduced by the taxonomy is omitted for the sake of clarity.

its substitute, and is temporary until the normal situation sets back in. It comes into effect immediately upon occurrence of the event and is typically defined a priori, though it is perceivable that the normal process may be substituted with an ad hoc, semi-structured process.

Adaptation is temporary by nature, viz. it is utilized on a case-basis rather than on a type-basis. It incrementally modifies those parts which need to change while preserving the structural identity of the business process. These modifications occur immediately in response to the event and the extent of possible modifications is typically planned a priori in order to not affect the integrity of the overall business process. Finally, *evolution* is an incremental modification of a business process over time. The changes it yields are permanent but may come into effect slightly deferred. In a typical scenario, the change is only enforced after a particular case has completed and organisational learning has led to the decision to preserve a certain modification. Evolution is an a posteriori response and as a result the required changes are planned and implemented as part of a continuous improvement initiative.

Table 1. Categorisation of Change Strategies

Strategy	Abstraction Level	Properties of Change			
		Extent	Duration	Swiftness	Anticipation
Substitution	*type*	*revolutionary*	*temporary*	*immediate*	*planned/ ad hoc*
Adaptation	*instance*	*incremental*	*temporary*	*immediate*	*planned/ ad hoc*
Evolution	*type*	*incremental*	*permanent*	*deferred*	*planned*

In the following, we will analyse the reported cases by applying the classification summarized in Table 1. Each case is characterized by the probability and impact of the event and the applied response strategy. Also, we discuss the duration of the effected change. In the following we give a verbal description of our findings and summarise them in a more structured format in Table 2. Of particular interest are the probability and impact of the event as well as the extent of structural modifications. In case of the automobile manufacturer, the probability of the event is low but the impact disruptive. The manufacturer decides to improve its risk profile by assessing vulnerabilities in its shopfloor processes and supply chain. Furthermore, the organisation selects *substitution* of these processes in the event of a disaster through an emergency response plan, which becomes effective *immediately*. A second component, *resumption* planning, identifies critical processes and people that perform them and defines how to restart operations at an alternative site.

The case of the pharmaceutical producer documents an example of failed process *evolution*. Probability and impact of the event is high. Contamination of lots is a *constant threat* in a pharmaceutical environment. Awareness of this threat and the binding regulations in the context of the process could have guided the responsible managers and engineers towards an improved process design that incorporates stringent quality controls. The failure to do so was further amplified by the fact that the plant

accounted for 50% of the North American supplies. Finally, the insurance company case portrays how effective process *adaptation* can be implemented. The event-based response system triggers different escalation categories leading to different variations of the process. These variations are *temporary* and reverted after the event. For instance, additional resources may be allocated through redeployment of employees from other departments and hiring of casual staff. In order to reduce average call handling time of casual staff, a streamlined 'rapid lodgement of claim' is applied.

Table 2. Classification of Cases

Case	Stimulus	Response
Automobile Manufacturer	A hurricane represents a major, critical event of temporary (i.e., passing) duration out of the control of the organisation.	**Anticipation.** Event is anticipated, and its impact exceeds the normal variety of processes. The organisation selects a *substitution* strategy and implements weather monitoring systems, evacuation procedures, and backup supplier networks. **Enforcement.** The overriding emergency response plan becomes effective immediately upon event occurrence and remains active for the duration of the event. **Resumption.** Resumption planning identifies critical processes and restarts operations at an alternative site.
Pharmaceutical Producer	Contamination of pharmaceutical products is generally perceived as a permanent threat. However, this threat can be countered by increased awareness and quality control. Negligence after acquisition of the plant and lack of executive awareness may explain the occurrence of the contamination.	**Anticipation.** Failure to realise the persistence of the threat, and failure to trigger process *evolution* towards stricter quality controls in the manufacturing process. Effect is amplified by the reliance of the North American market on the Liverpool plant for 50% of its supplies. **Enforcement.** As a result of the failed anticipation, the licence is suspended and manufacturing discontinued. **Resumption.** Large-scale corrective measures are triggered ad hoc.
Insurance Company	Damage through storms is common and frequent during the Australian storm season, but limited to certain seasons of the year.	**Anticipation.** Event is anticipated and an *adaptation* strategy is implemented through an event-based response system. Modifications are applied temporarily depending on storm severity. **Enforcement.** Existing operations are adapted though response systems, which trigger allocation of additional staff and enforce a streamlined claims processing process. **Resumption.** Resumption of normal operations after the event, i.e., upon change of season.

Towards IS Support for Process Change Strategies

In the following, we will give a brief overview of how current PAIS provide support for the different process change strategies. Most of the support focuses around the enactment phase and – to a lesser extent – on resumption (through learning algorithms). Only little support is provided for anticipation. The response strategies of adaptation and evolution receive the most wide-spread support today. One such approach is documented in [12], which allows for the specification of so-called pockets of flexibility in a business process design. Adams et al. [13] introduce the concept of Worklets, self-contained fragments which are dynamically selected at process runtime. Only the latter approach supports contextual decisions through a knowledge base and rules-based selection mechanism.

A compelling case of support for process model evolution is the ProCycle approach. The authors combine previous research in [14] into a system that allows the flexible, case-based extensions of process instances. Decisions are preserved in a semi-structured manner in a knowledge base, thus allowing the underlying process model to evolve over time. At this stage, the approach does not provide direct support for contextual drivers. The least support is available for the strategy of substitution, albeit we acknowledge that this strategy may be achieved through a combination of other methods. By way of example, a rules-based mechanism could trigger depending on the situation either a standard case or one of several substitute cases. In this sense, we consider the Worklet approach to yield the most promising results.

Conclusion and Outlook

Through a review of case studies, we have identified several recurring process modification scenarios and have generalised them into three process change strategies along temporal and structural attributes. We have furthermore suggested that these strategies are not performed in isolation but may occur concurrently and differ along the predictability and impact of the event and the extent of structural changes it effects on a business process. By reviewing related work, we have provided a brief indication of potential PAIS support. Even though our review is rudimentary at best, it suggests that more advanced support for context-awareness is required to adequately support process change strategies.

In our future work, we aim to further our understanding of the relation between change drivers and the change strategies they imply. We suggest that enabling context-awareness and support for process change strategies throughout the business process lifecycle, e.g., through context specification and enforcement, will yield more robust process models capable of dealing with disruptions in business processes.

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